Art. III.—*On the Caves Perforating Marble Deposits, Limestone Creek.*

By James Stirling, F.L.S.

[Read 12th April, 1883.]

During a recent examination of some marble deposits at the head of the Murray River (Limestone Creek), it occurred to me that a few measurements and observations on the interior of the caves by which these deposits are perforated might prove interesting. The following descriptions and diagrams are the result of such examination:—

Topography of Limestone Creek Valley.

Forming the most southern source affluent of the Murray, the Limestone Creek presents many important physiographical features. The southern and eastern watershed line is formed by the Great Dividing Range, culminating on the east in the rugged Cobboras mountains, 6025 feet above sea-level; while the western watershed line is formed by a high lateral range at a mean elevation of 4500 feet above sea-level. The general direction of the course of the Limestone Creek, from its source in the Dividing Range to its confluence with the Indi or Hume River, is north north-easterly, and the area of its catchment basin about 240 square miles.

Most of the small tributary streams have their source runnels in fine grassy upland flats, on the crests of the ranges forming the watershed lines, but as they near the parent stream traverse deeply eroded gorges in the mountain flanks, frequently forming cataracts and waterfalls of great beauty. This is more particularly the case with the eastern affluents, which are much shorter than the western.

The view obtained when descending the valley from the west, on the main route from Omeo to Maneroo, N.S.W., is very grand and impressive. Away to the north, just discernible in the distant horizon, looms the snow-capped peaks of the culminating ranges of the Australian Alps, Mount Kosciusko, and the Bugong Ranges, over 7000 feet above sea-level; in the middle distance rises the coned peak

of Mount Pilot, 6020 feet; to the east tower the serrated rocky ridges of the Cobboras mountains, 6025 feet; while intervening and winding amid bold, wooded ranges lies the gorge formed by the Limestone Creek valley. Along the course of the stream are a series of richly grassed open flats, backed in many places by low bluffy spurs, giving in their undulating contour and other appearances unmistakable evidences of calcareous deposits *in situ*.

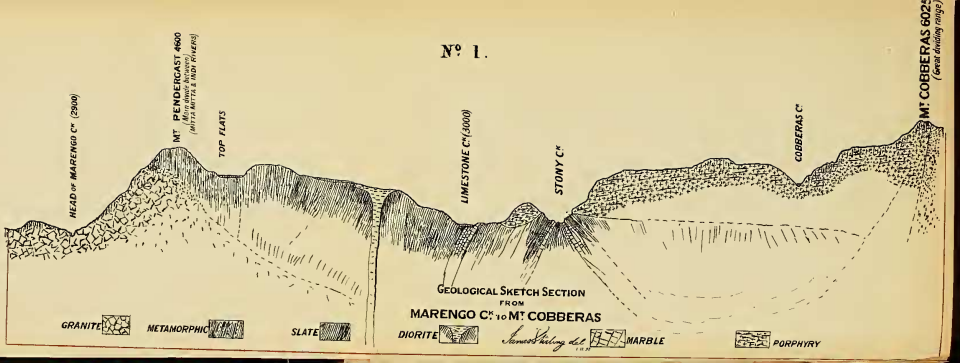
Geological Structure.

The eastern watershed (with the exception of the locality hereinafter mentioned as Stony Creek) is composed of masses of porphyries, fragmental and compact, the former from grains as fine as sand to blocks weighing many tons; while the western watershed is made up principally of slates, and interbedded bands of whitish marble and dense blue limestone. The slates merging on the western watershed line into a class of schistose rocks, bearing a strong resemblance to the metamorphic schists of the Omeo District.* Although the Limestone Creek may generally be said to have eroded its course along the contact of the sedimentary rocks with the porphyries, yet the latter, in the lower part of the stream, have been cut through, leaving precipitous banks on either side.

In order that the stratigraphical relation of the porphyries to the sedimentary rocks may be better understood, the following sectional notes and diagrams are given. The section was determined from personal observation, and crosses the Limestone Creek valley at right angles to the course of the stream.

Starting from the level of Marengo Creek (an eastern affluent of the Mitta Mitta), and proceeding easterly, we have, first, a mass of granitiform rock exposed on the bed of Marengo Creek; ascending Mount Pendergast coarse metamorphic schists, gneissic in character, are seen, showing apparently a vertical dip. As the crest of the range is reached these rocks become more micaceous, full of thin quartz seams, and corrugated along the line of strike, which is here seen to be N. 20° W. Descending towards the Limestone Creek some upland alluvial flats are passed over, with

* "The Diorites and Granites of Swift's Creek, and Their Contact Zones." By A. W. Howitt, F.G.S. *Royal Society of Victoria*, pp. 9 to 15.


Nº 1.
HEAD of MARENGO Cr (2900)
Mt PENDERGAST 4900
Mts HAWKINS
(WITH MITTA & INDI RIVERS)
TOP FLATS
LIMESTONE Cr (3000)
STONY Cr
COBBERAS Cr
Mt COBBERAS 6025
(west dividing range)
GRANITE
METAMORPHIC
SLATE
GEOLOGICAL SKETCH SECTION
FROM
MARENGO Cr TO Mt COBBERAS
DIORITE
MARBLE
PORPHYRY

here and there, on the crests of the dividing ridges, contorted schistose rocks protruding. These are both argillaceous and silicious in character, and generally finely laminated, showing a dip of from 70° W. to vertical at N.N.W. At lower levels a mass of diorite is met with, presenting in the weathering rounded boulders traces of its igneous origin. The soil formed by the disintegration of the latter is shown to be very fertile by the rich carpeting of grasses at this place. So far as I could judge from the altered indurated appearance of the rocks at contact, this mass has been protruded, or rather intruded, from deep-seated sources along the line of section, and not, as might be suggested, either interbedded with the sedimentary rocks, or the remnant of a once larger mass intruded elsewhere. The rock appears to be a mixture of felspar and hornblende principally. On the spurs descending the valley of the Limestone Creek the normal Silurian slates are seen, inclined at high angles, generally 70′ to W., and vary in colour from yellow to bluish grey—soft, yellowish sandstone, and micaceo-argillaceous slate, thin bedded or finely laminated. On the creek flats are deposits of tertiary gravels, frequently auriferous, and which may hereafter be profitably sluiced for gold. Several of the western tributaries of the Limestone Creek are also auriferous, and one, Slaty Creek, contains titaniferous ironsand with cassiterite.* On the east bank of the creek is a bluffy outcrop of what appears to be thin-bedded blue limestone, the beds varying from a few inches to as many feet thick, and inclined at an angle of 70′ to W., with strike to N.N.W., in fact, parallel with the slates with which they are interbedded. These apparent blue limestones, however, when broken, exhibit a crystalline, somewhat saccharoidal texture, and vary in colour from milky white to shades of light grey, and are found to be more or less full of thin yellow seams parallel to the bedding planes. The quality of this marble, on an analysis of hand specimens, seems good, yielding a small percentage of earthy matter, and a large percentage of carbonate of lime; yet even where the beds are thickest these seams would probably deteriorate from the commercial value of the deposit. Whether these seams are in any way due to the percolation of surface waters holding colouring matter, such as one of the oxides of

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* *Geological Survey of Victoria*, Vol. IV., p. 189.

iron, limonite, $H_6 Fe_2 O_9$, in solution; or represent thin seams laid down during the deposition of the calcareous sediments, and which have not been obliterated during the processes of consolidation by which it is probable these beds were metamorphosed from marine limestones into crystalline marbles, I am unable to decide; although, from the evident regularity and parallelism of the seams and their continuousness, together with the facts noticed when examining the structure of the marble in the interior of the caves, it is probable that the latter is the more correct explanation of their origin. The apparent thickness of this marble bed when crossed by the line of section does not exceed 250 feet. To the east the slates again appear, but, at contact with the marbles, very much contorted along the line of strike. Crossing an eastern affluent of the Limestone Creek (Painter's Creek), the porphyries are first seen, and the change is marked both in regard to the character of the soil and the vegetation.

On examination the rock is found to have a somewhat granular felspathic base, in which are scattered numerous irregularly-shaped patches of felspar, the dimensions of which may generally be about a quarter of an inch by an eighth of an inch in width. On ascending the hill side similar rocks are to be found, nearly to the first summit, but in places becoming more compact.* On descending towards Stony Creek similar rocks are met with, until at lower levels the slates again appear, presenting the same strike and dip, and without any more than the normal state of alteration as seen generally on the eastern watershed near the marble deposits. On a small spur abutting on Stony Creek are seen the deposits of fossiliferous blue limestone from which specimen No. 1 was taken.

At lower levels a tributary of Stony Creek—Round Mountain Creek—has laid bare another narrow band of finely laminated slates, which are succeeded by the Stony Creek marbles, consisting of rather amorphous or thick-bedded masses of whitish, greyish, pinkish, and variegated marbles, as seen in specimens Nos. 2, 3, 4, and 5.

In one place a ridge of undenuded porphyry remains overlying the marble deposits, as shown in sketch; while on

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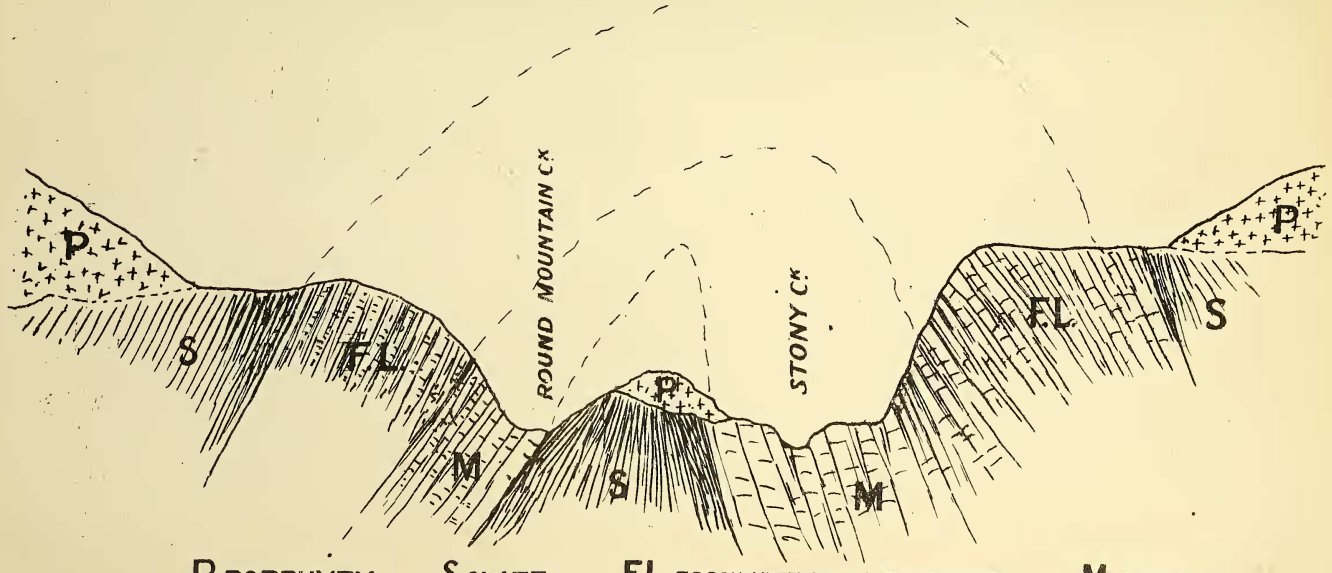
* *Progress Report, Geological Survey of Victoria*, 1876, p. 196. A. W. Howitt, F.G.S.

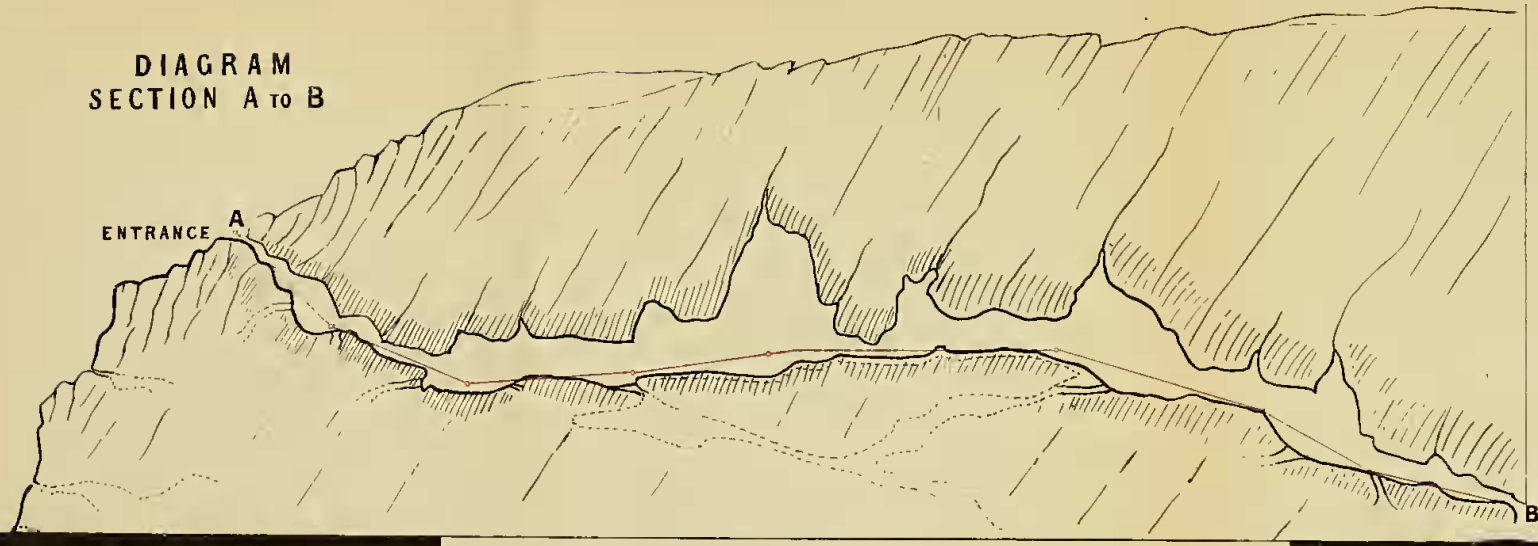
Nº 2.


P
S
F.L.
M
ROUND MOUNTAIN Cx
STONY Cx
P
S
M
F.L.
S
P
P. PORPHYRY.
S. SLATE.
F.L. FOSSILIFEROUS LIMESTONE.
M. MARBLE.

INTERIOR OF CAVE

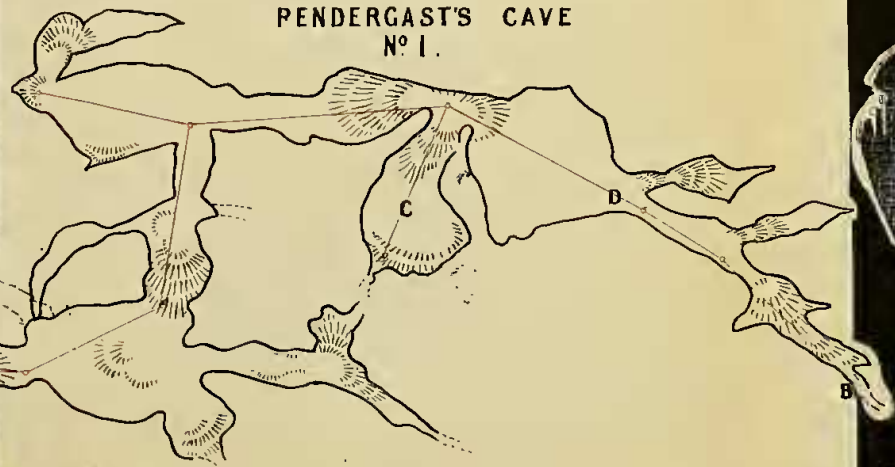
at D

DIAGRAM
SECTION A to B



INTERIOR OF CAVE
at D

PLAN OF
PENDERGAST'S CAVE
No. 1.



INTERIOR OF CAVE
at C.

the eastern bank of the creek the marble beds are capped by blue unaltered limestones containing fossils (molluscs).

In ascending the steep and rugged ranges to the east, the porphyries become more compact and silicious, having a greyish or reddish felsitic base, with small translucent quartz-crystals, patches of pink-coloured felspar and fragments of other rocks, the whole forming a breccia-like mass, as seen in specimen No. 6. On the summit of Mount Cobboras, and on the rocky-crested ridges near it, the rock masses weather into vertical layers with a northerly strike. Descending the eastern slopes of Mount Cobboras, the porphyries previously described give place to salmon-coloured quartz-porphyries, almost granitic in structure and weather in rounded masses.

EXAMINATION OF CAVES.

Cave No. 1.—Pendergast's Cave.

The first examined is that perforating a marble deposit near the Limestone Hut (an out-station of Mr. James Pendergast, of Mount Leinster). For reference this may be called Pendergast's Cave. In examining the ground plan of this cave (Diagram 3), it will be seen that it traverses generally the line of strike of the strata. This is the case with most of the caves examined, and would appear to indicate their origin to be by percolation of water from the adjoining creeks. What I mean by this is that the present water channel of the Limestone Creek, although in some cases at a lower level than the orifices forming the entrances to the caves, originally stood at a much higher level, and washed the bases of the limestone bluffs; then, percolating along the lines of strike, gradually eroded a channel to a lower level; and, owing to the calcareous mass being traversed by joints and lines of shrinkage, the water charged with carbonic acid gradually decomposed the hard crystalline masses, and by the further mechanical action of silt and small stones eroded a larger passage. The action of rain water from above, acting similarly by its carbonic acid, derived from the decomposing vegetable matter covering the calcareous deposits, would probably form many of the curiously-shaped holes and crevices seen on the surface.*

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* *Vide* Boyd Dawkins' *Cave Hunting*, p. 53.